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Seasonal Dimorphism in Arisaema Triphyllum.

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(With 5 figures drawn by the author.)

Along the Maryland Pike from Silver Hill to Clinton, Prince George County) are several tracts of woodland, mostly with *Liriodendron, Liquidambar, Nyssa, Acer rubrum* and various oaks. There are many creeks and frequently, during the winter months, large areas of the woods become inundated. There is a luxuriance of ferns, notably *Woodwardia areolata, Asplenium Filix-femina, Polystichum, Onoclea sensibilis, Dicksonia, Osmunda,* and even the rare *Ophioglossum vulgatum* is quite abundant.

But when the Spring commences there is no trace of *Podophyllum, Sanguinaria, Claytonia, Anemonella, Dentaria, Erythronium or Osmorhiza;* the vernal Grasses are scarce. But there are many *Carices,* and *Symplocarpus* is at its very best, not to speak of *Viola cucullata, Oakesia,* and *Rhus Toxicodendron,* while *Orontium* follows the creeks. Not until late does *Arisaema triphyllum* appear in these surroundings, and when it commences to bloom, the plant on the Potomac shore near Washington has passed flowering more than a month earlier.

When finding this plant near Clinton barely in bloom in the middle of May, its remarkable low stature attracted my attention, beside the late time of its appearance. *"Nana"* or *"Serotina"* would have seemed an appropriate name, but it so happened that the plant proved to be the variety *pusilla* already described by Peck,[1] and recently raised to specific rank: *A pusillum* (Peck) Nash in Britton's manual.

However, considered as a mere variety or at least as a form this plant seems more interesting than as a new species. It actually indicates how a species may be developed, and from

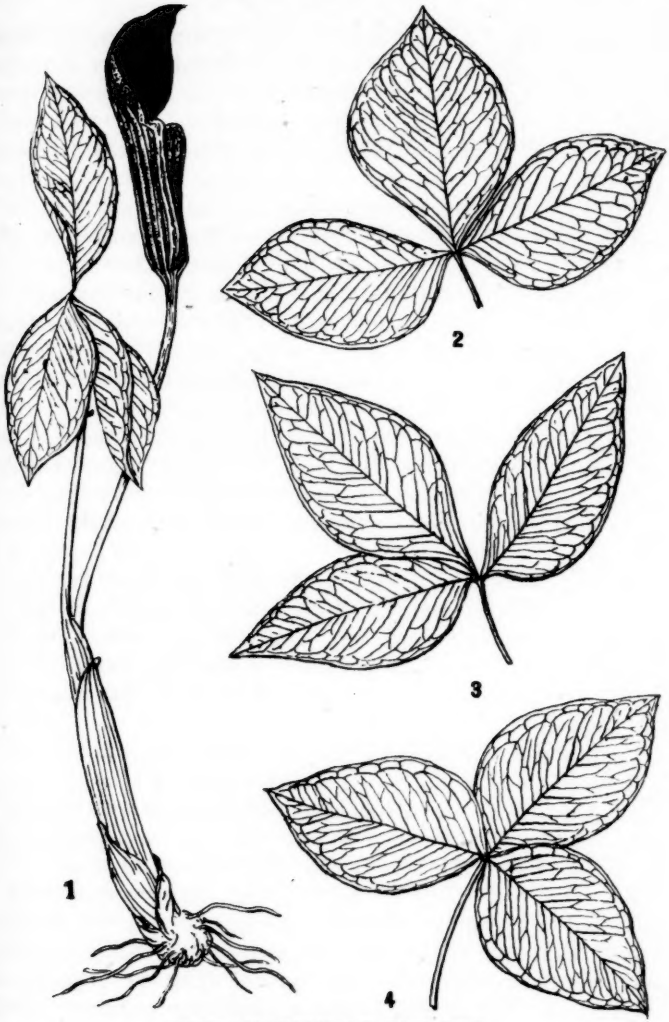
1 Report New York state Museum 51: 297. 1897.

this point of view the plant will be treated in the subsequent pages. Peck (l. c.) describes the plant as follows: "Plants 3 to 6 inches high; leaves usually solitary, the leaflets narrowed and pointed at the base, 12 to 18 lines long, 7 to 9 wide; the upper part of the spathe commonly dark purple. Millbrook, Dutchess county, June. The plants were in flower June 15th; about a month later than the time of flowering of the typical form of the species in the same locality." No additional characters are mentioned in Britton's manual, and the habitat is given as "open sunny bogs New York."

Having had the opportunity to study the plant throughout the summer, and in localities where it occurs in abundance, I have observed several points in its external structure, by which it may be readily distinguished from the typical form. So far as concerns the vicinity of Washington (Maryland and Virginia) typical *Arisaema triphyllum* appears to be mostly dioecious. It is a plant of rather robust habit, especially when compared with the var. *pusilla* (Fig. 1) at the corresponding state. The leaf-segments are elliptical-ovate, pointed, and they are very broad in young specimens (Fig. 4), which have not yet reached the flowering state. The relative length and width of the middle segment correspond well with those of the two lateral. The color of the spathe varies from light green to dark purplish-brown or variegated with dark purple and whitish stripes or spots.

Now with regard to the var. *pusilla* (Fig. 1) the plant is very slender with the scape frequently bent; the spathe and spadix are smaller than in the type, and the color of the spathe is most often dark purplish-brown to almost black or, though more seldom, pale green with no dark spots or stripes. The staminate plant seems to be the most common, and I found no monoecious specimens. The staminate plants are generally of a lower stature than the pistillate, but the color of the spathe varies in both.

While the name *"pusilla"* is very appropriate to the plant, so far as concerns the small size of the leaves, spathe and spadix, when it appears above ground, the stem or floral scape, does not remain low, but grows rapidly, and may reach the height of 25 to 34 cm. in fruiting specimens, measured from the corm to the base of the spadix. The foliage may



EXPLANATION OF FIGURES.

Figure 1. *Arisaema triphyllum* (L.) Schott. var. *pusilla* Peck; two-thirds of the natural size.

Figures 2 and 3. Leaves of young specimens of same variety, in third year; two-thirds of the natural size.

Fig. 4. Leaf of a young specimen of typical *Arisaema triphyllum* in its third year; two-thirds of the natural size

Fig. 5. Leaf of a mature specimen of the variety *pusilla*; natural size.

also attain quite a considerable size. Concerning the shape of the leaf-segments, these are generally narrower than the type. This difference is evident even in young specimens (Figs. 2-3), which have not yet reached the flowering state. In mature leaves the relative size and outline of the segments are quite distinct from that of the typical plant. As a matter of fact it seems characteristic of the variety *"pusilla"* that the central leaf-segment is shorter and broader than the two lateral. Furthermore, the lateral segments often exhibit an outline approximately falcate. Among the numerous specimens which I examined, leaves in which the three segments were of uniform shape and size were rare. The leaf figured (Fig. 5)may give some idea of the general size and outline of the leaf of a mature specimen of the variety. The largest leaves are of course to be found in fruiting specimens. When two leaves are developed the basal is always larger than the superior. For instance in a fruiting specimen, collected on the second day of August the two leaves showed the size as follows:

Basal leaf: central segment, length 16.5 cm. width 9.0 cm.
Basal leaf: lateral segment, length 22.0 cm. width 7.0 cm.
Superior leaf: central segment, length 14.0 cm. width 5.5 cm.
Superior leaf: lateral segment, length 15.0 cm. width 5.4 cm.

In a staminate specimen, collected on May 31st, the single leaf measured:

Central segment length 9.5 cm. width 4.2 cm.
Lateral segment length 12.0 cm. width 3.1 cm.

As compared with the typical plant the variety *pusilla* is thus readily distinguished by (1) its late appearance, late blooming and fruiting; (2) the relatively smaller size of inflorescence, spathe and spadix; (3) the uniform deep color of the spathe, except in chlorotic specimens; (4) the leaf-segments being narrower, and the two lateral being generally longer and narrower than the central (Fig. 5); (5) the approximately falcate shape of the lateral segments; and finally (6) the habitat being either low woods, partially inundated during the winter, or sphagnum-bogs.

I have not, so far, found the typical plant and the variety growing together, and considering the nature of the surroundings, I presume these to be the direct environal cause

of the modified structure observable in the variety *pusilla*. In other words *Arisaema triphyllum* illustrates a case of seasonal dimorphism, which might eventually lead to the segregation of a second species, similar to the species of *Gentiana* and *Euphrasia*, described by Wettstein[2], and *Alectorolophus* by Sterneck.[3]

In his very instructive work, Grundzüge der geographisch-morphologischen Methode der Pflanzensystematik (Jena 1898), Wettstein points out the possibility of ascertaining the phylogenetic relations of species by a comparison of the morphological structure and the geographical distribution. As a point of issue this author maintains, that a species occupying an area, where the conditions suffer no change, may remain constant, except in case of eventual hybridization or individual variation. But, if the conditions become modified in some part of this area, or if the species spreads beyond the limits of the regions with other conditions, the species will naturally adapt itself to the new environments, and so result in the development of a new species. Such new species may be readily connected with the parental, when the areas are not too remote from each other. Some transitional forms may be observed, which morphologically resemble both. If, however, species is capable of being distributed across areas of wide extent, the transitional forms may become obliterated and the actual relation between the parent species and the modified form may be obscured. From whatever cause the species may have become modified it is evident that seasonal dimorphism is one of the fundamental results in such modification.

Such is unquestionably the case in the European species of *Euphrasia* and *Alectrorolophus*, which have become modified so as to represent distinct species, simply produced by the changes of conditions at harvest-time in the European meadows.

The history of *Gentiana* is somewhat different. We are here dealing with species, some of which are so closely related to each other that "annual" or "biennial," flowers "large" or

2 Wettstein, R. v. Der Saison-Dimorphismus als Ausgangspunkt für die Bildung neuer Arten in Pflanzenreiche. (Ber. Deutsch. Bot. Ges. XIII: 303. Berlin 1895.)

3 Sterneck, I. Beiträge zur Kenntniss der Gattung *Alectorolophus* (Oesterr. bot. Zeitschr. 1894.)

"small," and leaves "obtuse" or "acute" constitute some of the most important characters of distinction, yet with a geographic distribution of so marked characteristic, that their validity as species appears indisputable.

Figure 5. Leaf of a mature specimen of the variety *pusilla;* natural size.

Regarding *Arisaema triphyllum* we have a clear case in which "seasonal dimorphism" has produced a type, which I believe is about to develop as a distinct species. And there

cannot be any question of the parental species being the one, which we call typical *A. triphyllum*. For considering its morphological equipment, expressed by the characteristic structure of its organ of vegetative reproduction, the tuberous rhizome, such rhizome belongs to plants inhabiting higher situations, where it typically grows, and not to such as occur in low woods, inundated during the winter, or in bogs, sphagnum-bogs for instance. In the singular environment where the variety *pussilla* occurs, we have a natural explanation of the reason, why it blooms so much later than the typical plant. And accompanying this distinction as to time of flowering and fruiting we have seen the marked color of the spathe and spadix, the frequent variation in the leaf-outline, and the slender stem. If these characters remain constant, *"pussilla"* may eventually deserve specific rank, and we shall have a well founded proof of how some species may arise and "from more than one single area." For it is hardly possible to believe that the variety *pussilla*, as it grows in Maryland, originally came from the north, where it also occurs, or vice versa. It might have become distributed by means of the berries, but it seems much more reasonable to suppose, that the change of environment has produced this particular type, "wherever it occurs." A conclusion to that effect would only corroborate the view advanced by Wallace: "that every species has come into existence coincident both in space and time with a pre-existing closely allied species"—with the typical form of *Arisaema triphyllum* in this particular case. We would at the same time see no obstacle against believing that each species does not need to have been produced within one area, from where it migrated as far as it could; the origin of the Euphrasiae, the Gentianae, the species *Alectorolophus*, and our variety of *Arisaema* seem to depend on factors, some of which are among those which Schouw evidently had in mind, when he wrote his thesis: "De sedibus plantarum "originariis"[4] and reached the conclusion: "Eadem momenta cosmica easdem plantas diversis in locis produxise."

This hypothesis of Schouw was not new however, for it had actually been proposed by Gmelin in his "Sermo de

[4] Kjoebenhavn 1816.

novorum vegetabilium post creationem divinam extortu.[5] It was accepted by some few of the leading botanists, for instance, by Elias Fries[6]; but while Alphonse De Candolle once adopted and strenuously maintained Schouw's hypothesis,[7] he has in effect discarded it in his "Géographie botanique" (1855).

Since then very little has been written about this subject, at least from the viewpoint of Schouw; there is, however, an interesting paper by K. Mueller: "Uber das relative Alter der Alpenflor,"[8] in which the probability of several centers of creation is amply discussed in favor of Schouw's hypothesis. Indirectly, on the other hand, the question was brought up again by Kerner,[9] who demonstrates the possibility of hybrids giving rise to new species, when conditions are favorable. And we learn from another publication by this same author,[10] that Asyngamy i. e. Asynchronogamy may result in the formation of new species by means of favoring hybridization, and by rendering formation of new races possible.

Then with respect to seasonal dimorphism, we have in the works of Wettstein, Sterneck and Murbeck, cited above, an excellent illustration of the origin of certain species through factors, that may undoubtedly have exercised the same influence during epochs previous to the recent, and not being confined to a single area, but effective wherever the conditions are favorable.

CLINTON, MD., NOVEMBER, 1921.

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5 Tübingen 1749.

6 Den Linnéanska Botanikens forhallande till den nuvarande (Botaniska Utflygter Vol. 3. p. 114 Stockholm 1864).

7 Fragment d'un discours sur la géographie botanique. Bibl. univ. 1834.

8 Botan. Zeitg. Vol. 16. No. 43. p. 321. 1858.

9 Konnen aus Bastarten Arten werden? (Oesterr. Botan. Zeitschr. Vol. 21. No. 8.

9 Konnen aus Bastartem Arten werden? (Oesterr. Botan. Zeitschr. Vol. 21. No. 8. 1871.)

10 Uber die Bedeutung der Asyngamie für die Entstehung neuer Arten. (Bericht. naturwiss. Vereins Innsbruck 1874.)

The Evolution of Tools and Implements.

WILLIAM D. JOHNSTON.

Man's happiness today is dependent upon the comforts with which he is surrounded. His home, his clothes, his city, and the great complexity of present day society are the things that make life desirable. The society of which he is a part is dependent for its existence upon a great multiplicity of mechanical devices. Thousands of men go to the steel mills each morning to care for the great furnaces where millions of tons of ore are converted into iron. Thousands of men go to the factories to make machinery and tools from the iron. Again, men use the tools to make machines—great mechanical devices—huge lathes capable of turning an engine wheel; dry docks to float the longest ship; valves through which an automobile can pass—it is upon these things we depend today. They did not come suddenly, but through long, continual inventive effort to use the materials at hand to the greatest advantage.

Before the invention of metals, man's supply of materials with which to work was the flint quarry, the gravel bank, and the chert ledge. His weapons and tools were made of stone; at first in the pieces just as they were picked up; later they were roughly chipped, and in the time just preceding the invention of bronze they were elaborately chipped, polished and often carved.

When man discovered that copper and copper and tin alloys would lend themselves to shaping quickly by pounding, and that the weapons so made could be ground to an edge much sharper than that obtainable in stone, he did not hesitate to discard the quarry for the mine. His stone implements were reproduced in bronze and improved as the toughness and malleability of the metal suggested. His daggers were longer, his axe shorter and less unwieldly, and his arrows had sharper points.

The supplies of bronze were limited, and hence its use was not greatly extended. It was only with the invention of iron smelting processes that man entered into the era of invention and manufacture whose comforts today we enjoy. With such supplies of metal at hand there was no limit to the advancement of mechanical invention. Steel followed as a logical re-

sult, and with the advent of scientific thought and its application to the industries, the mechanical progress in the last hundred years has been enormous.

Let us suppose that a colony of present day people, dependent upon a vast multiplicity of mechanical devices for their well-being, be deprived of all of these things which they look upon as necessary to life and be left upon some island well supplied with the flints, the ores of copper and tin and of iron. Supposing still that, in the course of the first six or seven generations, the metals remained undiscovered and the people had accustomed themselves to an existence upon such plants as could be found and game brought down with stones. The customs of their modern forefathers would soon be forgotten and they would revert to the savagery necessitated by their environment. Then would doubtless follow a repetition of the series of discoveries and inventions which marked man's advance to his present day status. The improvement of stone weapons, the discovery and use of bronze, the use of iron, and then of steel, would come even as it came before. It is true that such a colony would have the mental advantage of hundreds of generations of intensive thinking and inventive people, and that mentally they would be of a type much higher than the primitive users of unworked stones. For this reason the progress would probably be more swift, but the order and method of invention would undoubtedly be the same.

The classification of M. Adrien de Mortillet of simple tools in five groups is given in Table II. His first group contains tools for cutting, edge tools probably the first type to be developed . The older stone flakes referred to the Chellean, found in river terraces of the Paris basin, while known as a "hand-axe" by the English archaelogist, is better described by its French name—the Coup de Poing[1]—and was doubtless grasped in the hand and used as a knife.

From the roughly broken stone fragment held in the hand up to the elaborately chipped blade-like daggers of the American aborigines, made with a skill that no white man possesses, is simply a process of educational evolution—one process leading to the next.

Pointed knives of bone are found in the kitchen middens of

1. Geikie, Jas. Antiquity of Man in Europe. 1914. P. 43.

old Hochelaga[2] and knives of bamboo cane are used today by some Polynesian tribes.[3] Elsewhere bamboo is used in making handles for other implements.

Many peoples make elaborate handles for rude knife blades, and the preservation of the blade alone, a crudely chipped piece of flint, would give a very low impression of the mechanical art of the people, although the handle by which it was attached may have been elaborately worked.

The primitive shear was a flat flake of flint held in one hand and pressed against a flat stone held horizontally much as a saddler's draw-knife or a cigar maker's clip is used today. It may have been provided with a handle as the "ulu" or woman's knife of the Eskimo.[4]

The shear made of two movable blades passing over each other was found in ancient Egypt and in China, but was doubtless invented after the "ulu"type of shear had been in long use.

The axe is a development of the stone knife. It would be very difficult to wield a knife as long as many axe-heads without the use of a handle. It was doubtless a red letter day in the history of invention when some Acheulean genius found that by wrapping vines about a sharp flake of flint and twisting the ends into a handle he had produced the first axe.

Axes are in general use throughout Paleolithic times. The method of attachment to a handle varies greatly. In the Solutrean of South Africa[1] axes were found with slight longitudinal grooves chipped in such a manner as to be firmly held when inserted into a split stick. The head was often locked to the stick by means of green raw-hide which, contracting greatly in drying, binds the blade firmly to the handle. Many of the polished axe heads of Neolithic times are grooved to receive the split handle or lashings, as are many of the axes of the American Indians.

Matlocks, adzes and chisels must be considered as adaptations of axes. A stone axe, while of little use in chopping a log across the grain, is of great use mounted as an adze in splitting it or in hollowing it in the manufacture of a canoe. Likewise, the chisel is but an axe head set in a handle so that the blade is at the end of the handle, and a matlock a longer

2. Dawson, F. W., Fossil Men and Their Modern Representatives. 1870. P. 135.
3. Polynesian Researches, Vol. IV., P. 346.
4. Mason, "The Ulu, or Woman's Knife," Rep. U. S. Nat. Mus. 1890. Pp. 411-416.

adze. The stone blade in these types of cutting tools differed but little among primitive people, the same blade being used for all purposes.

The bronze celts of the Swiss Lake Dwellers are classical examples of the reproduction of stone tool types in bronze.

Osborn[6] fails to include the flint saw in his tables of implements, but Mason[7] mentions flint pieces with serrated edges found in many European as well as American caches. These flakes are carefully made and seem to be adaptable for no other purposes than hacking a piece of wood or bone in two.

The use of thin strips of soft wood and sand much as the modern quarryman cut his block of marble into slabs was probably known in Paleolithic times; undoubtedly in Neolithic.

In ancient Egypt a bronze saw was used, and very primitive cross-cut saws of the same metal are in use today in China.

The Aztecs and some modern Polynesian tribes make saws by inserting teeth and bits of stone in a wood handle.[8]

M. Adrien de Mortillet's second group comprises those instruments used for abrasion and for smoothing. He includes in it scrapers, gravers, rasps, files, sandpaper, polishers, burnishers, whetstones and grindstones.

The use of abrasives can not be considered a fundamental operation. Chipping and crushing doubtless came first and the abrasive process was used in finishing the tools roughly shaped by pounding or chipping.

Scrapers were used to prepare skins for use as clothing and coverings. The process of skinning an animal needs necessarily be crude when done with stone knives, and the use of a scraper to remove the mangled flesh from the skin is a normal development. They appear in the Chellean and are most conspicuously deveolped in the Mousterian and the Aurignacian of the Middle Paleolithic[9].

The instruments used in polishing stone are of small importance in the Paleolithic, but assume a prominent place among the implements of the Neolithic. Mason[9] tells of the many reports sent annually to the Smithsonian at Washington telling of the discovery of large blocks of sandstone whose

5. Johnson, J. P. The Prehistoric Period in South Africa. 1910. P. 51.
6. Osborn, H. F., Men of the Old Stone Age. Pp. 270, 271.
7. Mason. The Origin of Invention. 1901. P. 48.
8. Ibid. P. 48.
9. Loc. Cit. P. 52.

surface shows marks of abrasion indicating their use as grindstones.

The "kitchen middens" of the north of Europe contain whetstones made of the best material the locality affords. Today the whetstone is used by all savage peoples. Often hammers and axes show abrasive marks, telling of their use as grindstones.

Etchers and burnishers come into importance in the bronze age and many of the "Swiss Lake" implements are elaborately etched and doubtless were highly polished when new.

The third division of M. de Mortillet's includes implements use for fracturing, crushing and pounding.

Chipping instruments are in use by all savage people who work in such rock as flints and cherts. Almost all papers discussing flint blocks and arrows go into considerable detail in describing the method of using a pin of bone to do the final finishing of the implement. Today the implements are made of such materials as bone, antler, hardened wood and stone.

In using the chipper, the flint is held in the hand against a piece of leather or another stone, and pressure is exerted downward near the edge of the flint. In this way thin flakes of the material are chipped away and the implement fashioned.

Osborn[10] in his table does not include the chipper among his bone instruments, but there is no doubt that some of the instruments classified by him as chisels or as smoothers were used for this purpose.

The hammer is the universal tool. Dawson's[11] account of the evolution of the hammer is very good. He recognizes these types of hammers:

"Disc-hammers are in their rudest form merely flat pebbles, suitable to be held in the hand, for driving wedges or chisels, or for breaking stones, bones, or nuts. In their more finished forms they are carefully fashioned of quartzite or greenstone, with one side convex and the other flat, or even slightly hollowed, and the edge neatly and regularly trimmed. Stones of this kind are found all over America on old Indian sites, and are almost equally common in Europe; and there can be little doubt from the habits of the modern Indians as to their ordin-

10. Loc. Cit.
11 Dawson, F. W. Fossil Men and Their Modern Representation. London, 1880. Pp. 112-115.

ary uses. They were probably hammers, pounders and polishers. Held with the convex side in the palm of the hand, they could be used to drive wooden stakes or to split wood with stone chisels, or to crack nuts or to bruise grain and fruits, or to grind paint on a flat stone. With sand or earth they made efficient polishers for dressing skins, and held edgewise they served to trim flint weapons or to crack marrowbones. One of these hammers must therefore have been an indispensable utensil in every household, and a well-made one of durable stone may have been an heirloom handed down for generations.

"The second kind of hammer is of elongated form, round or oval in cross-section, and suited to be held in the hand, though, perhaps, in some cases lashed to a wooden handle. It much resembles the ordinary stone axe or celt, but differs in having a blunt end, indented with blows, instead of an edge. This almond shaped hammer was employed to chip stones, to drive wedges, and to break nuts and bones. One example from Hochelaga has a rough depression on one side, which may have been produced by hammering wedges with the side instead of the end, or may have been intended to give a better hold to the end of the handle. Hammers precisely of this kind are found in the caves of Perigord and in Sweden. The savages of all countries seem to have discovered that dioritic rocks, from the toughness of the crystals of hornblende which they contain, are specially suited for the formation of these hammers, so that wherever greenstone can be found it is employed.

"The third and most artificial kind of stone hammer is that with a groove around it, by means of which it could be attached to a handle or slung upon a tough withe. Such a hammer is sometimes merely an oval pebble with a groove worked around it, but some examples, especially those of the old mound builders, are elaborately grooved and carefully shaped; and there are some with two grooves, the working of which must have cost much labor. Some specimens are so small as to weigh only a few ounces, and one from the ancient copper mines of Lake Superior, now in the museum of the Geological Survey of Canada, is 11½ inches long, and weighs more than 25 pounds. The larger end of it has been much bruised and

broken, and it was evidently a miner's sledge-hammer. Grooved stones of this kind occur on prehistoric sites in Europe, though they have sometimes been regarded as plummets or sling-stones. In America similarly grooved pebbles are often found in circumstances which lead to the belief that they have been sinkers for nets. These are, however, usually of stone too soft to have been used for hammers, and have no marks of use on the ends. The ordinary sinker for lines and nets is, however, on both sides of the Atlantic a pear-shaped or drop-shaped stone, with a grove for the line at the sharp end."

Grinding apparatus is in universal use. The mortar appeared in Azilian times but flat stones were used for crushing grain long before. The lava mortar of Mexican peons is in use extensively in Mexico, and is but little better than those of much more primitive cultures.

In M. de Mortillet's fourth class are included instruments designed for use in perforating.

The borer is recognized from Pre-Chellean times, and remained a recognizable, though not conspicuous, element in the cultured throughout Palaeolithic times. It was used largely for boring out pieces of wood for blade sockets and in the dressing of the skins of the animals slain by the primitive man. Its use upon stone is uncertain in the Palaeolithic, but the use of rock drills in the Neolithic is well shown by the axe-heads of polished stone having a socket for the insertion of a handle found in the late Paleolithic.

The use of stone drills among the North American Indians is attested to by the presence of the calumet in any large collection of Indian implements.

The needle appeared in Magdalean times and was conspicuous among the implements of the Azilian and Tardenoisian. It was usually in the shape of a long thin piece of bone, without an eye, and used much as the shoemaker's awl is today. With it the old stone age people sewed the animal skins to make clothing.

The late Neolithic and the Bronze Age needles were more elaborate[12] and were in many cases provided with eyes. Other boring tools of the Bronze Age were gimlets, and punches, but the prototype of the modern augur is absent. The principle

12. Am. Rep. Peabody Mus., Cambridge, 1887, Pp. 581-586.

of the screw was unknown and may be considered a true product of modern invention, for in Archaelogical discussion Archimedes has not as yet been relegated to the "bone yard."

M. de Mortillet's last class included implements for grasping and joining. He divides this into two sub-groups, (a) including such articles as tongs, pincers, vices, clamps, and wedges, and (b) nails, lashings and glues.

Logically his second group should come first, for glues and lashings are known to savagery long before pincers and clamps.

From the most primitive culture, in fact wherever implements of stone are used, they are set into handles, and use is made of glue to hold them there. The Australian "black-boy" holds the stone point in the javelin, and modern Indians imbed a part of the blade of their flint daggers in pitch to provide a handle.

Nails are not new. Their forerunner—pins—are found in the upper Paleolithic made of bone. The Mormons used wooden pegs to hold together the timbers of their tabernacle at Salt Lake just as timbers are joined in China today. The buildings of the primitive peoples have long ago been destroyed, but it is not logically wrong to suppose they used such methods of joining as do peoples of comparable cultures who live today.

The vice and pincers are recent devices. When the old stone age man split a stick to insert the javelin point and then bound the split stick below the point with green rawhide he was using the principle of the vice. The old fable of the bear whose head became fastened in a split log when he dislodged the wedge which held it apart in his eagerness for the honey it contained, suggests to us the possible manner in which the vice was invented. Later day types in the late bronze age are included in collections of Roman tools.

In the discussion of these types of implements a parallelism has been attempted between the modern savages and those old types whose cultures are comparable with those of present day types. On the whole, this parallelism is satisfactory, and the use of many an old tool has been explained by the observance of present-day savage people.

TABLE I.

SUCCESSION OF HUMAN INDUSTRIES AND CULTURE.*

V. Later Iron Age.—Europe, 500 B. C.

IV. Earlier Iron Age.—(Hallstatt Culture.)—Europe, 1000-500 B. C.; Orient, 1800-1000 B. C.

III. Bronze Age.—Europe, About 2000-1000 B. C.; Orient, About 4000-1800 B. C.

II. New Stone Age, Neolithic.

3. Late Neolithic and Copper Age. (Transition period).—Europe, 3000-2000 B. C.

2. Typical Neolithic Age (Swiss Lake Dwellings).—Europe 7000.

1. Early Neolithic stages (Campignian culture).—Europe.

I. Old Stone Age, Palaeolithic.

Upper Palaeolithic—Europe.

8. Azilian—Tardenoisian.

7. Magdalenian (Close of post-glacial time).
6. Solutrean (Beginning of post-glacial time).
5. Aurignacian (Beginning of post-glacial time).

} Reindeer, Shelter, Drift, and Cave Period—12,000 16,000 B. C.

Lower Paleolithic.

4. Mousterian (Fawlk—Glacial time).—40,000 B. C.

3. Acheulean (Transition to Shelter).
2. Chellean.
1. Pre-Chellean

} River, Drift and Terrace Period 100,000 B. C.

Eolithic.

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* Osborn, H. F., Men of the Old Stone Age. 1916. Scribners. P. 18.

TABLE 2.

M. ADRIEN DE MORTILLET'S CLASSIFICATION OF SIMPLE TOOLS.*

I. For Cutting. Edge Tools.
Working—
1. By Pressure
   a. Knives.
   b. Double-edge tools, shears.
   c. Planes.
2. By Shock
   a. Axes.
   b. Adzes.
   c. Chisels, gouges.
3. By Friction
   a. Saws.

II. For Abrasion and Smoothing.
Working—
1. By Pressure and Friction.
   a. Scrapers, gravers, rasps, files, sandpapers, polishers, smoothers, burnishers, whetstones, grindstones.
2. By Shock.
   a. Bush-hammers.

In wood-working fire is an efficient element in abrasion.

III. For Fracturing, Crushing, Pounding.
Working—
1. By Pressure.
   a. Chipping and flaking implements.
2. By Shock.
   a. Hammers, pestles.
3. By Friction
   a. Grinding apparatus, mills.

IV. For Perforating.
Working—
1. By Pressure and Friction.
   a. Needles, prickers, awls, drills of all kinds.
2. By Shock.
   a. Punches, pricks.

V. For Grasping and Joining.
1. Tongs, pincers, vises, clamps, wedges.
2. Nails, lashings, glues.

* Mason, Otis T. The Origin of Invention. Scribners, 1901. Page 34. Cit. "Rev. Mensuelle de l'Ecole d'Anthrop. Paris."

TABLE 3.

THE STONE IMPLEMENTS CHARACTERISTIC OF LOWER AND UPPER PALAEOLITHIC TIMES.*

The Typical Stone Implements.	Pre-Chellean	Chellean	Acheulean	Mousterain	Aurignacian	Solutrean	Magdelenian	Azilian	Magdelenian
A. War and Chase.									
1. Arrow Point, etc.							§	§	†
2. Point			§	†	†	§	§	§	
3. Lance or Knife					§	†	§		
4. Lance-Head					§	†	‡		
5. Lance-Head					‡	†	‡		
6. Hand-Axe, Poniard, etc.		†	†	§					
7. Throwing Stone	‡	‡	§	§	‡	‡	§		
8. Knife	§	§	§	§	§	§			
B. Industrial and Domestic.									
9. Lamp							§		
10. Polisher						§	§		
11. Mortar							§		
12. Chopper		‡	§	§					
13. Hand-Axe, etc.		†	†	§					
14. Planing Tool	§	§	§	§	§	§			
15. Scraper	§	§	§	†	†	§	§	§	
16. Drill, Borer	§	§	§	§	§	§			
17. Knife	§	§	§	§	§	§			
18. Anvil Stone					§	‡	§		
19. Hammer-Stone	§	§	‡	‡	§	§	§	§	
C. Art, Sculpture, Engraving.									
20. Drill, Graver, and Etcher					§	§	§	†	§
21. Chisel					§	§	§		
22. Etching Tool					†	†	§	§	
23. Graver (Also mortar, hammer-stone, and polisher)					†	§	§	‡	

* Osborn, H. F., Men of the Old Stone Age. Scribners, 1916. P. 270.

§ Twice mentioned (in different classifications).

† Denotes an unusual or culminating development.

TABLE 4.

THE BONE IMPLEMENTS APPEARING AT THE CLOSE OF THE LOWER PALAEOLITHIC AND HIGHLY CHARACTERISTIC OF THE UPPER PALAEOLITHIC.*

The Typical Bone Implements.	Aurignacian	Solutrean	Tardenoisian	Azilian	Tardenoisian
A. War, Chase, Fishing.					
1. Blades		§	‡	§	
2. Dagger			§	§	
3. Fish-Hook		‡	‡	‡	
4. Spear Thrower				§	
5. Harpoon			§	†	§
6. Javelin Point		§	§	§	
7. Spear Point		§	§	§	§
B. Industrial and Domestic.					
8. Spatula			§	§	
9. Shuttle				§	
10. Pin.				§	
11. Needle	§	§	†	†	
12. Blades		§		†	
13. Anvil	§				
14. Smoother		§	§	§	§
15. Wedge		§		§	
16. Chisel		§		§	§
17. Awl	§	§	§	§	§
C. Ceremonial, Social.					
18. Ceremonial Staff		§	†	†	
19. Wand				§	

* Osborn, H. F., Men of the Old Stone Age. Scribners, 1916. P. 271.
§ Twice mentioned (In different classifications).
† Denotes an unusual or culminating development.

Nomenclatorial Notes on Certain American Plants—II.

HOMER D. HOUSE.

The second edition of Britton & Brown's Illustrated Flora (1913), attributes a number of generic names to Philip Miller's 4th Abridged edition of the Gardner's Dictionary (1754). An examination of the copy of this work in my library shows that there are several generic names which should likewise be credited to Miller. Among such names, the most important, as refering to the flora of the northern and eastern United States are the following:

Abies (Tourn.) Mill.
Alnus (Tourn.) Mill.
Larix (Tourn.) Mill.
Castanea (Tourn.) Mill.
Sabina (Bauh.) Mill.
Bistorta (Bauh.) Mill.
Fagopyrum (Tourn.) Mill.
Paronychia (Tourn.) Mill.
Quamoclit (Tourn.) Mill.
Melo (Tourn.) Mill.
Tithymalus (Tourn.) Mill.
Filapendula (Tourn.) Mill.
Ulmaria (Clus.) Mill.
Cotinus (L.) Mill.
Opuntia (Baugh.) Mill.
Petasites (Tourn.) Mill.
Polygonatum (Bauh.) Mill.
Onagra (Tour.) Mill.

Of these it might be noted that the first species cited by Miller for Onagra, is a non-binomial, pre-Linnaean name referable to *Oenothera biennis* L. Likewise under Eruca which Dr. Britton takes up and credits to Miller, the first species cited is referable to *Brassica Erucastrum L.*, and not to *Brassica Eruca* L.

CUNILA (L.) MILLER

This is based upon "*Cunila calycum lacinia superiore latiore ovato trinervos,*" Linn. Hort. Cliff., which is *Sideritis romana* L., in the Species Plantarum (1753), and is quite a different species than the one which is taken by Linnaeus himself for the type of Cunila (Syst. Ed. 10, 1359. 1759). This latter is *Satureia origanoides* L. (1753); *Cunila mariana* L (1759), *Cunila origanoides* Britton.

Kuntze (Rev. Gen. Pl. 520. 1891) has taken up for this genus, the Cunila of Linnaeus (1759), the name Hedyosmus Mitchell (Act. Phys. Med. Acad. Nat. Cur. 8: App. 211. 1748), hence the name should be cited Hedyosmus (Mitchell) Kuntze (1891). The Index Kewensis refers this name to Zizophora

L., a closely related genus, but not having seen the original publication of Hedyosmus, I am unable to state upon what grounds. Another name referable to the type *Cunila mariana* L., is *Mappia* Heist.; Adans. (Fam. Pl. 2: 193. 1763), which under the American code of nomenclature becomes the correct name for this group of the Mint family. Mappia Jacq. 1797, has generally been recognized as a valid genus of the family Olacaceae, and for it will have to be substituted the name *Leretia Vell.* (Fl. Flum. 99; 3: t. 2. 1825). L. affinis Miers, L. ampla Miers, and L. cordata Vell, to which may be added *L. angustifolia* (Griseb.) comb. nov. (*Mappia angustifolia* Grieseb.) and *L. racemosa* (Jacq.) comb. nov. (*Mappia racemosa* Jacq.

The plant of the Mint family heretofore known as *Cunila mariana* L., may take the name *Mappia origanoides* (L.) comb. nov. (*Satureia origanoides* L.)

CAPNORCHIS (Boerh.) Miller.

This name is usually credited to Borckhausen (Roemer's Arch. 1: 46. 1797), and Bicuculla Adanson (1763), has been taken up in several recent publications because it had priority over Capnorchis Borckhausen (1797). Dr. B. L. Robinson (Syn. Fl. 1: 94. 1895) remarks: "Much would have been saved if Bernhardi had taken up the name Capnorchis." Miller's adoption Capnorchis in 1754 will be especially welcome to those who object to Adanson's name. Most of the species of the genus have at one time or another been taken up in Capnorchis, viz:

Capnorchis Cucullaria (L.) Planch.
Capnorchis eximia (Ker.) Planch.
Capnorchis formosa (Dryand.) Planch.
Capnorchis chrysantha (H. & A.) Planch.
Capnorchis canadensis (Goldie) Kuntze.
Capnorchis uniflora (Kellogg) Kuntze.
Capnorchis orchroleuca (Engelm.) Greene.
Capnorchis pauciflora (Wats.) Greene.

Capnorchis occidentalis (Rydb.) comb. nov. (*Bicuculla occidentalis* Rydb.)

BORBONIA (Plum.) Miller.

This is based upon *"Borbonia fructu oblongo nigro, calyce coccineo,"* Plum., and of which Miller says,—"is pretty common in South Carolina, from whence the seeds were brought by Mr. Catesby to England,—called black-berried Bay in Carolina." This is *Laurus Borbonia* L., the type of Tomala Rafinesque, a generic name taken up by Dr. Small.

Borbonia Borbonia (L.) House, comb. nov. (*Laurus Borbonia* L.)

Borbonia littoralis (Small) House, comb. nov. (*Persea littoralis* Small).

Borbonia humilis (Nash) House, comb. nov. (*Persea humilis* Nash.

Borbonia pubescens (Pursh) House, comb. nov. (*Laurus carolinensis* var. *pubescens* Pursh).

PERSEA (Clus.) Miller.

This is usually credited to Gaertner (1805), and is maintained by Dr. Small as a genus distinct from Borbonia (Tomala). By others Borbonia (or Tomala) is included in Persea. In the latter case Borbonia Miller (1754) has priority of position in Miller's arrangement.

CURURU (Plum.) Miller.

This is based upon *"Cururu scandens ennaphylla, fructu racemoso rubro," Plum.*, which is *Paullinia curassavica* Linn. (*Serjania curassavica* Radlk.). Miller's second species is the reference to Plumier's species which is Paullinia pinnata L., and the third one is referable to Paullinia Cururu L.

Cururu curassavica (L.) House, comb. nov. (Paullinia curassavica L.)

In this connection it is important to note that Miller also adopts Serjania (Plum.), usually credited to Schumacher (1794). The arrangement by Miller being alphabetical, Cururu comes first. The species which Miller lists under Serpania are referable respectively to *Paullinia polyphylla* L. (*Serjania polyphylla* Schum.), *Paullinia mexicana* L., and *Paullinia sinuata* L.

Cururu pinnata (L.) House, comb. nov. (*Paullinia pinnata* L.)

Cururu Cururu (L.) House, comb. nov. (*P. Cururu* L., *P. nodosa* Jacq. *Serjania nodosa* Radlk.)

Cururu polyphylla (L.) House, comb. nov. (*Paullinia polyphyll* L.)

Cururu mexicana (L.) House, comb. nov. (*Paullinia mexicana* L.

Cururu sinuata (L.) House, comb nov. (*Paullinia sinuata* L.)

Cururu brachycarpa (A. Gray) House, comb. nov. (*Serjania brachycarpa* A. Gray).

Cururu racemosa (*Schum.*) House, comb. nov. (*Serjania racemosa* Schum.)

Cururu incisa (Torrey) House, comb. nov. (*Serjania incisa* Torrey).

GUAIABARA (Plum.) Miller.

This is based upon "*Guaiabara alia racemosa, foliis oblongis,*" Plum., and is referable to *Polygonum Uvifera* L. (Coccolobia P. Br., 1756; Coccoloba Linn., 1759). The other two species listed by Miller are taken from Houston.

Guaibara Uvifera (L.) House, comb. nov. (*Polygonum Uvifera* L.)

Guaibara laurifolia (Jacq.) House, comb. nov. (*Coccoloba* laurifolia Jacq.)

Guaibara venosa (L.) House, comb. nov. (*Coccoloba venosa* L.)

This is a large genus of chiefly tropical American plants.

New York State Museum
Albany, N. Y.

The Geography of Bird Study.

O. A. STEVENS, FARGO, N. D.

Some time ago the writer undertook to make a brief survey of the work which was being done by the various organizations interested in bird study and protection. The present article is an attempt to show the relative interest in birds in different parts of the United States and to offer some reasons for such distribution. A tabulation of the reports in Bird Lore for December 1917, supplemented by those of 1918 and 1921 gives the following result:

	1917	1918	1921
State Audubon societies sending reports	20	17	14
State Audobon societies affiliated but not reporting	6	6	8
Local clubs sending reports	42	42	49
Local clubs affiliated but not reporting	53	72	76

The reports for three years are included as a check on the general trend of the data, rather than for a comparison of the three years. The distribution of these among the different states is shown on the accompanying map, but in order to simplify the details, the number of affiliated clubs for 1921 only is represented. The result may not be quite accurate but is certainly a general index to the interest in birds.

Nine states are entirely blank and about an equal number nearly so. Barely one-half have a state organization. The question arises, what is the function of a state organization, and what is its relation to the local clubs. In some, notably, New York, we see a fine development of the latter without the former. Probably different conditions would be met equally well by diverse organizations. It seems to the writer that the local club is the natural and necessary source of interest but that there should be a real place for the state association in uniting these. The number of organizations for 1921 shows an increase in fourteen states and a decrease in eight as compared with 1917, but the difference is small in most cases.

The distribution of Junior Audubon members provides a second and different method of estimation. Of the 18 states

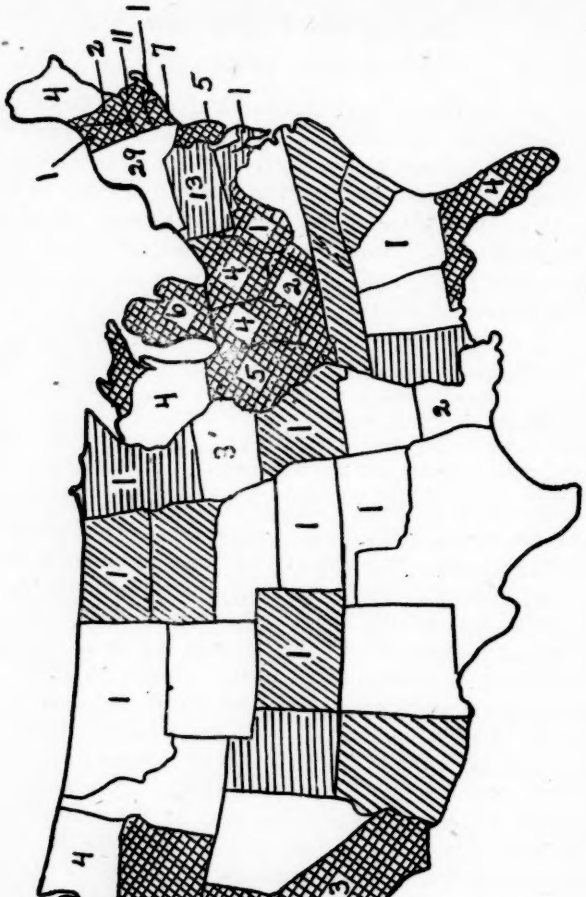

FIG. 1. Map showing distribution of State Audubon Societies and local clubs affiliated with the National Association. Numbers indicate local organizations affiliated in 1921. Double cross lines indicate state societies submitting reports in 1917, 1918 and 1921; single diagonal lines, report for at least one year; horizontal lines, affiliation for at least one year but no report submitted.

with the lowest showing on the map, only 7 have over 1000 Juniors in 1921; only one of the latter (Nebraska) has over 2000 and the average of the 18 is about 900. For 15 states having 3 or more local clubs, the average is over 8000, only one (Maine) having less than 4000.

The reasons for such distribution seem to be several, and to relate to both bird and human population. The following list may be useful as a basis for study:

1. People—number, character and education.
2. Birds—number, whether resident or migratory.
3. Environment—topography, plants, climate.

These conditions are rather complex, one often affecting one or more of the others. Density of population is probably more important than any other single one, since only a certain number of people may be expected to be naturally interested in birds. This proportion increases to a certain extent with education and may also vary in different sections according to the character of the population. Comparing the map of density of population (Literary Digest for Oct. 29, 1921) with the one here presented, a fairly close agreement is noted. Bird study runs lower in the south-eastern states except Florida where it is higher. It is high also in Indiana, Michigan, etc. These differences can probably be accounted for by character of population.

As to number of birds, migration plays a prominent part. Of the 1200 kinds of birds found in the United States and Canada, one-fourth or more may be seen in a single state. The phenomenon of migration makes one of the strongest appeals to the mind of man but it is to the majority of people of more temporary interest than the study of nesting habits. Thus while migration adds very greatly indeed to interest in birds, the matter of summer residence probably offers the strongest permanent interest. The counts thus far made have indicated a higher number of summer residents for the eastern states.

The character of the country has important influences of many kinds. Lack of trees and especially of thickets reduces the number of tree nesting species. A country of varied topography will have many kinds of birds as there will be ponds for water birds, meadow or prairie for ground dwellers, tall

trees, bushes, bank, cliffs or caves for their respective kinds. Such country offers also a greater variety of plants, insects and other animals which furnish food supplies. Trees, while desirable, have limitations. A dense forest, especially, is composed of only a few kinds of trees, offers only a limited range of conditions and may be as barren of birds as the treeless plain. Fortunately the effect of such conditions often is relieved by proximity of areas of different type.

Climate is important as determining the distribution of birds. It controls their study as well to a considerable extent. The majority of people interested in birds are those who are drawn afield by pleasant weather rather than those who are out regardless of the temperature and moisture. The northern plains in winter or the southern plain in summer offer conditions which are favorable to neither bird nor student.

Changes in population affect also the bird population. This greatly decreases the numbers of certain species (indeed we regret that it has even caused complete extinction of some), but has the opposite effect on others. With an even moderate protection any locality should retain an interesting bird life. The writer has felt that often the greatest need of bird study is for people with natural ability to direct the work. With less capable leaders much more time and energy must be used. This suggests that it is desirable to try especially to interest those who show such ability in other work.

BOOK REVIEWS

In this section are reviews of new, or particularly important and interesting books in the fields of natural science. Books dealing with botany or kindred subjects should be sent to the Editor, the University of Notre Dame. *All other books for review* should be sent to Carroll Lane Fenton, at the Walker Museum, the University of Chicago, Ill. Publishers are requested to furnish prices with books.

LIFE OF ALFRED NEWTON. By F. R. Wollaston. E. P. Dutton. $7.00

To hold one position in a great university for 41 years is something of an achievement, but it does not provide a great deal of spectacular material for a biographer. No matter how interesting the work, or how enthusiastic he may be, the scientist who spends his years in a laboratory or class-room cannot be the splendid, gilt-rimmed figure that we are accustomed to look for in biographies. All of this Mr. Wollaston admits at the beginning of his book, and in the absence of adventures in the life of his subject, he goes to the letters which the great professor wrote, as well as those he received. This move, a necessity rather than a choice, has, however, considerable advantages, for it gives the book almost the character of an autobiography.

Alfred Newton entered Magdalene College, Cambridge, in 1848. Six years later he received the Norfolk Traveling Scholarship, and by means of it conducted ornithological field work in Lapland and Iceland, and visited the United States and the West Indies. In 1863, after having done a great deal of work with birds, he moved to Cambridge, making it his permanent home. In 1866 he was appointed professor of zoology and comparative anatomy in the University, and at once began to improve the zoological museum, and to enter into the general life of the university. Mr. Wollaston bears most effective testimony of the fine influence which Professor Newton exerted among students, and numerous letters quoted show that he was equally popular among gatherings of scientists. This association with undergraduates as well as with specialists is an all-important thing for a college instructor who would be something more than research specialists or teaching machines, yet it is neglected, in America at least, by a great number of worthwhile men.

Professor Newton was a staunch Tory, and in all things a conservative. Old things were best; new ones should always be opposed. In politics, while against such men as Gladstone, he did not make any public efforts in the way of campaigns or speeches. Professor Newton showed no such reticence about college affairs. He strenuously opposed such minor affairs as singing at chapel, and the building of a pipe organ where no instrument of any type had been before. But despite his fierce intolerance and violence of prejudice the Professor was a good

loser, a fair judge, and a keen humorist. Mr. Wollastons' book seems to be a good deal like the character of the man whose life he tells, whether by intent or by accident we cannot, of course, determine.

C. L. F.

JOHN BURROUGHS—BOY AND MAN. By Clara Barrus, M. D. Doubleday, Page & Co.

The author of the volume "Our Friend, John Burroughs," has produced another book, not quite so formless as the first, but still far from satisfactory. The sincerity of Dr. Barrus' desire to bring out an informational account of a very noted man, and the wealth of detailed knowledge which she possesses are evident, but nevertheless she has failed to write a good book. Perhaps ten or fifteen years from now, someone who does not know John Burroughs too well, and who is therefore able to write a really representative biography will do what Barrus has attempted and failed.

In the first place, the book is strangely organized. The chronological method of arrangement is not well suited to a character study, which is evidently the aim of the book. Also Dr. Barrus, along with many others, overestimates the later work of John Burroughs. She tries to make him appear a philosopher as well as a naturalist, which he hardly could claim to be. John Burroughs as a writer of nature essays is deserving of praise; John Burroughs as a nature critic and as a philosopher is a much less striking figure. Because he was a big-hearted, kind old man, who could write beautiful English, knew a great deal of natural history, and had a number of rather spectacular eccentricities that were played upon by magazine writers, the nation idolized him. Nature study clubs had "Borroughs days," and "Burroughs programs;" some book dealers went so far as to label him "America's most noted naturalist." Burroughs became a fad, and as a result we have such books as this one. Some day we may have a clearer evaluation of Burroughs, and then, a worth-while biography of an interesting man.

C. L. F.

A MANUAL OF THE VERTEBRATE ANIMALS OF NORTHERN UNITED STATES. By. David Starr Jordan. 12th Ed. A. C. McClurg & Co. $3.00.

This latest edition of Dr. Jordan's standard is highly pleasing. Its purpose is to give students and collectors a ready means of identification, and a comprehensive survey of the characters on which the orders, families, species, etc. of the animals they find are founded. To this end Dr. Jordan makes use of a system of analytical keys by which the differential characters are brought into the sharpest possible contrast. The oustanding fault with these keys in the early editions of the book, namely, the introduction of artificial characters for purposes of differentiation, has been corrected. The keys, while they tend to give the beginner the idea the classification is based on differences rather than

on similarity, are unquestionably of value. And their very abbreviation makes it impossible for the very new beginner in zoology to use them and therefore gain erroneous ideas that he will later have to do away with.

The nomenclature of the book is old. In the attempt to keep the cost of the volume as low as possible, pages have not been reset in cases where only names would be changed, the necessary corrections being made in the appendix. Also, numerous subspecies and varieties are lacking; thus in the *Laniidae* we find no mention of the very important subspecies *L. ludovicianus migrans*, the Migrant Shrike. It would seem that, if the book is to be maintained as a standard manual, it would be worth the while of both the publisher and author to keep it strictly up-to-date. Students are apt to pay $4.50 or $5.00 for a good, reliable, modern work, where they will hesitate sometime before investing $3.00 in one that while on the whole pleasing, in the part is very much antiquated. C. L. F.

THE NEW PROGRESSIVE GEOGRAPHIES: CALIFORNIA. By Harold W. Fairbanks. Harr Wagner Publishing C. $1.50.

The failings of the old type school geographies are too obvious to need much explanation. Anyone who has waded through the smaller Frye only to be confronted by the larger one, and who found when through with both that the sum of his knowledge was a little—a very little—above zero does not require further proof. I went through both; I learned the states in their order, and the capitals for each state. I learned that cotton grows in Texas and that it is made into cloth in England and (I think) Connecticut. I did not know why cotton grew in Texas; I did not know why there were falls where mills might be located. I did not know why some place was the capital of Maine, nor why its population was a certain number of thousands, hundreds, and units. I knew no whys, and I remember very little geography. I could not now, for the life of me, name the states in the Union. But I can tell why cotton grows in Texas; why there are waterfalls in some regions and none in others. If some one will put the cause as well as the effect into geography it will cease to be a mechanical affair, and become a live study.

This is precisely what Dr. Fairbanks tries to do. His book for California is final; there will be no "follow-up" volume, and the student may begin it with a light heart in that respect. Facts are treated from the problem side; questions are asked or statements made, and then the grounds for the answer expected or the fact laid down are made clear. Peninsulas are more than "necks of land mostly surrounded by sea;" they are real things, that had a beginning and a growth. The aborigines are not mere curiosities briefly mentioned; they are made real by this problem method of treatment. While I

have never taught geography, and probably never shall, I hope that Dr. Fairbanks will produce other books of this high quality and progressive type. C. L. F.

LESSONS IN ELEMENTARY PHYSIOLOGY. By Thomas Huxley. Sixth Edition. Revised by Joseph Barcroft. Macmillan & Co.

This book, by no means so very elementary as its title might indicate, begins with a "General View of the Structure and Functions of the Human Body." It first considers the functions and form of the body as a whole, and then of the various parts, closing with two most interesting sections, "Life and Death" and "Modes of Death." There follow sections on the circulatory organs, the lymph and lymphatic system, the composition, qualities, and functions of blood, respiration, alimentation, and kindred subjects. The section on motion and locomotion considers those activities in their intimate connection with bodily structure; the sections devoted to the sensory organs deal also with the senses produced by them, the coalescence of sensations, and certain oustanding facts of consciousness. The one dealing with nerves and innervation is especially complete and clearly written. It should be of value not only to the student of physiology, but to those who wish a general physiological groundwork for studies in psychology.

The book is one which, from beginning to end, shows careful, purposeful organization. There is no trace of padding in any chapters, and yet there is a sufficiency of detail for a book of its general and introductory character. It is worth a place on the bookshelf of any zoologist or physiologist, and in these days, when we hear so much of mechanistic concepts of man, "man as an adaptive machine," and so on, it is not without value to the generally educated layman.

C. L. F.

HOW TO KNOW TREES. By Henry Irving. Funk and Wagnalls.

This is a convenient little volume, written in popular and most attractive English. It treats the common trees of Great Britain, both native and introduced, in a manner that seems to satisfy the demand of Oliver Wendell Holmes when he said: "What we want is the meaning, the chaarcter, the expression of a tree, as a kind and as an individual." There are no artificial keys; no hard, unbeautiful diagrams. Each tree is described with necessary detail, but without technicality. The illustrations, which are excellently selected, show these characters of the trees which can most readily be distinguished by the layman who, though interested in the facts of nature, does not care to systematize them and so become a scientist. Someone would do well to write a similar volume on American trees, or the trees of some particular area of this continent. C. L. F.